

Review of Sridhanya (Nutricereals)-“A Sustainable Ancient Era Super Food with Health Benefits”

Gupta Tulasi*, Gupta Rashmi**, Pandey Neha*, Dr. Vijaylakshmi Gautam***

Abstract-

Millets are one of the initial foodstuffs consumed by humans and perhaps the first cereal grain employed in household cooking. Since ancient times, millets have been a primary source of nutrition for the inhabitants in semi-arid tropics in Asia and Africa, where other crops do not thrive. India and Asia have both been major millet consumers for centuries. Millet seeds are ground to create the Indian flatbread known as Roti. The area used for millet cultivation has been declining over the previous 50 years, especially since the green revolution period, despite all these outstanding traits and capacity of millet farming systems. The little "grain" is free of gluten and rich in vitamins and minerals. Good quality protein, minerals, dietary fibre, phytochemicals, and vitamins are all abundant in millet grain, which is also extremely nutrient-dense. As compared to rice and wheat, millets' nutritional profiles are examined. Foxtail millet, proso millet, and pearl millet all have protein levels that are higher than those of wheat. Kodo, little, foxtail, and barnyard millet have higher fibre contents. Interestingly, finger millet has 344.00 mg of calcium per 100g. Millets are added to cereal-based food products, which have grown in popularity due to their nutritional and practical advantages. As consumers believe millets and meals made from millet directly affect their health, value-added millet products have the potential to bring value to businesses and have significant growth potential. In order to further raise public awareness of millets' positive effects on health.

Introduction- Millets are a traditional staple food of the dry land regions of the world. In India, millets are grown on about 17 million ha with annual production of 18 million tonnes and contribute 10 percent to the country's food grain basket¹. They are nutri-cereals which are highly nutritious and are known to have high nutrient content which includes protein, essential fatty acids, dietary fiber, B-Vitamins, minerals such as calcium, iron, zinc, potassium and magnesium. It helps in rendering health benefits like reduction in blood sugar level (diabetes), blood pressure regulation, thyroid, cardiovascular and celiac diseases². However, the direct consumption millets as food have significantly declined over the past three decades. The major reasons of decrease in consumption is the lack of awareness of nutritional merits, inconveniences in food preparation,

* Ph.D.Scholar, Department of shalya Tantra, Faculty of Ayurveda Institute of Medical Science, Banaras Hindu University, Varanasi, Uttar Pradesh, India.

** Associate Professor, Department of shalya Tantra, Faculty of Ayurveda Institute of Medical Science, Banaras Hindu University, Varanasi, Uttar Pradesh, India.

*** Professor, Department of Rachana Sharir, Faculty of Ayurveda, I.M.S., B.H.U., Varanasi, U.P., India.

lack of processing technologies, and also the government policy of disincentives towards millets and favoring of supply of fine cereals at subsidized prices. It has become imperative to reorient the efforts on the sorghum and millet crop to generate demand through value-addition of processed foods through diversification of processing technologies, nutritional evaluation and creation of awareness backed by backward integration^{1, 2}.

In that context it is important to explore ways for creating awareness on nutritional merits of millets. The importance of nutrition as a foundation for healthy development is underestimated. Now-a-days people are very conscious about their healthy living practices to overcome metabolic disorders and life style diseases³. This publication deals with the review on the scientific empirical studies on the nutritional aspects, functional aspects and health benefits of millets from seed structure to processed products, which are conducted in India and elsewhere across the globe⁴.

Further, it deals elaborately with nutritional evaluation of the value added sorghum product technologies that have been developed and standardized under the IIMR-led consortium of NAIP subproject on millets value chain conducted by NIN⁵. The products have shown to have high nutritional values and the micronutrient studies conducted have reported these to have relatively low glycemic index and glycemic load⁶. Sorghum/millet processed products recipes and the method of preparation are embedded with content that can be of some use to various stakeholders, researchers, academic fraternity.

Pearl millet (*Pennisetum glaucum*)

Pearl millet is widely grown indigenous millet commonly known as *Bajra* and cultivated in sandy soil with lesser irrigation requirement. Due to higher oil content (4–9%) pearl millet can easily be stored at low temperatures and moisture conditions⁷. These are rich in both the micro and macronutrients and its flour is consumed in various bakery and traditional food items.

Its phytochemical constituents help in lowering cholesterol levels and maintaining lipid profile⁷. It contains substantial amount of folate, copper, zinc, iron, magnesium, calcium, vitamin B complex, and unsaturated fatty acids^{7, 8}. It contains high folate makes it a biofortificant against the anemic population. The presence of magnesium can foster the treatment of migraines and also can reduce the respiratory problems in asthmatic patients.

Pearl millets also contain some phytonutrients such as apigenin, flavonoids, lignin, and myricetin that help in preventing breast cancer, cardiovascular disease and are anti-fungal and anti-ulcerative^{8, 9}. It is reported that pearl millet also induces the hypoglycemic effect and improves the lipidemic control in diabetic rats.

Foxtail millet (*Setaria italica*)

Foxtail millet is the second highest grown millets in India commonly known as Kangni¹⁰. These are generally cultivated in semi-arid areas and require less irrigation. Foxtail millets are antipest and contain a good amount of protein, dietary fibre, calcium, vitamins, iron, and copper and also help in increasing disease resistance capacity¹¹. It is non-acid-forming and non-glutinous,

so easily digestible. It helps in steadily releasing sugars in the body without hindering body metabolism. It contains catechin, quercetin, and apigenin, kempherol that helps in combating diabetes, cardiovascular disease, and maintaining dyslipidemia. Due to the magnesium content it is known as healthy heart food. It is anti-microbial, anti-tumorigenic and helps in body detoxify.

Foxtail millets show the anti-ulcer response along with pervasive antioxidant effect and protect the gastric mucosa.

Barnyard millet (*Echinochloa* spp.)

Barnyard millet is the rapidly grown millet crop generally harvested within 6 weeks commonly known as *Swank* or *Shyama*¹². It is rich in protein, dietary fibre and some of its soluble and insoluble fractions and low carbohydrate. It mainly contains 3 fatty acids; linoleic acid, palmitic acid, and oleic acid. Barnyard millet is very effective in reducing the blood sugar level and due to its gluten-free nature; it also prevents from celiac diseases¹².

It contains anti-oxidative phenolic compounds, flavonoids, and serotonin derivatives, and shows very strong anti-oxidative activity. Luteolin, N-(p-coumaroyl), serotonin, and triclin are its major compounds that are anti-cancerous, anti-rheumatic, and anti-diabetic¹³.

Little millet (*Panicum miliare*)

Little millet is commonly known as *Gajrao*¹⁴. It contains around 37–38% of dietary fibre and good amount of protein. It can be utilized for snacks, baby foods, processed foods, etc. It contains apigenin that helps in combating diabetes, celiac disease, cardiovascular disease, high cholesterol level, and is anti-cancerous¹⁴. These are also good for wheat intolerant people. Little millets are rich in phosphorous and iron and also carry a high amount of vitamin-B. Germinating little millets are the good sources of α -amylase with higher purity and specific yield.

The soluble fraction of little millets contains around 80% of phenolic (caffic, ferulic and sinapic acids) and flavonoid (kaempferol and luteolin) contents¹⁵.

Finger millet (*Eleusine coracana*)

Finger millet is an annual, dry season crop that is adjusted to fairly reliable precipitation conditions¹⁶. It contains considerable amount of protein, dietary fibers, essential amino acids, vitamin A, and vitamin-B. It also contains a high amount of calcium (10 times as compared to rice and wheat) and phosphorous and helps in controlling high blood cholesterol, constipation, and intestinal cancer^{16, 17}. It is considered as the best food for diabetic people and controls hyperglycemia and blood sugar levels.

It also contains catechin, myricetin, epicatechin, triclin, epigallocatechin, luteolin, taxifolin, kempherol, vitexin, daidzein, gallicocatechin, pyrocyanidin B1, apigenin and pyrocyanidin B2, all these are vital in diabetes and cardiovascular disease treatment¹⁷. Finger millets are anti-microbial and anti-tumorigenic in nature.

Another study has recommended that an instant health beverage powder supplement or an extract of finger millet can use to combat the calcium-deficient diseases. The study also reveals that this drink can compete with any sort of health drink available in the market.

Quinoa (*Chenopodium quinoa*)

Quinoa is considered as pseudo-cereal or pseudo-grain due to its high protein content. It can grow at an altitude of around 3500–4000 above mean sea level (MSL) in cold and high and climatic zones and used in cooking, baking, or as green fodder, animal feed, and pellets¹⁸.

It has gained huge attention from Asia, Europe, and the United States due to its higher minerals, protein, and vitamin composition. In India, quinoa cultivation is done in the high altitude area of the Indian Himalayan region. It contains flavonoids, polyphenols, and phytosterols with some possible nutraceutical properties^{18,19}. It contains high amount of protein, dietary fibre, minerals, and vitamins that help in combating diabetes, protein-energy malnutrition, celiac disease, maintaining dyslipidemia, cardiovascular disease, and intestinal health. It is rich in iron, magnesium, copper, phosphorus, potassium, and zinc and also contains lysine and methionine amino acids which are lacking in cereals¹⁹. Besides, quinoa is considered as an oil crop due to the high amount of available oil, omega-6 fatty acid, vitamin-E, and vitamin-B.

Sorghum (*Sorghum vulgare*)

Sorghum is a traditional staple food for the dry land population of the world and commonly known as *Jowar*²⁰. Worldwide sorghum is the fifth highest produced crop and fourth in India. Its nutritional qualities are better than rice and it contains β -carotene, folic acid, fibre thiamine, and riboflavin²⁰. Sorghum is rich in condensed tannins, flavonoids, and phenolic acids. Its antioxidant and pigments level are competitive to vegetables and fruits. Sorghum is anti-carcinogenic and lowers esophageal cancer.

It also contains protein, vitamins like vitamins B1, B2, and B9; some essential minerals like calcium, iron, potassium, phosphorus, sodium, and zinc; dietary fibre, etc. Sorghum is highly nutritive and prosperous millet contains a high amount of nutritional value than rice or wheat and having nutraceutical properties that help in fighting both pre and post-transition problems such as, arthritis, heart-related cardiovascular diseases, less body weight, and body mass index (BMI), malnutrition, obesity, etc²¹.

Kodo millet (*Paspalum scrobiculatum*)

Kodo millet is drought resistant, pest resistant, thermophilic xerophytes plant that is native to subtropical and tropical regions of Africa that have become indigenous Indian millet as it has domesticated here around 3000 years ago²².

Kodo millet is commonly known as *Kodra*. *Kodo* millet has the highest dietary fibers concentration as compared to other millets and an ideal food for diabetic patients. It contains a high amount of protein, low-fat content, a considerable amount of vitamins like folic acid (B₉), niacin (B₃), pyridoxine (B₆), and some minerals like calcium, iron, magnesium, potassium, zinc, etc^{22,23}. Due to lack of gluten, it is used by the gluten or wheat intolerance people. *Kodo* millets also contain lecithin which is good for strengthening the nervous system. Consumption of *kodo* millet is good for post-menopausal women that are suffering from high cholesterol problems or

dyslipidemia, high blood pressure, and heart-related diseases. *Kodo* millet can significantly decrease diabetes in rats caused by alloxan and can be used in rendering general debility, hemorrhages, hepatopathy, and inflammation²³. The stem of kodo millet's plant can be used as a poultice if suffering from beriberi while the concentrate of kodo roots can be used as diuretic and galactagogue.

Proso millet (*Panicum miliaceum*)

Proso millet is an ancient important crop of the human diet particularly in Asia, Australia, Europe, and the USA. The common name of proso millet is *Chena* having shorter growing season²⁴.

It contains high amount of calcium, dietary fibre, protein and is gluten-free. It is the most inexpensive source of manganese in contrast to other available nuts, spices, and cereals. It helps in lipid profile improvement and cholesterol reduction.

Proso millets are good for bones and also help in combating cardiovascular diseases and breast cancer. Carotenoids extract of proso millet has very high cellular antioxidant activity as compared to fruits and vegetables. Proso millets have higher anti-proliferative activity against the human liver cancer cells but dose dependant. It contains around 65% of phenolic compounds and rich in some bioactive phytochemicals like caffeic acid, chlorogenic acid, ferulic acid, and syringic acid that all are beneficial for human health^{24,25}. The protein concentrate of proso millet significantly increases the glycemic response and but decreases the insulin level in mice.

Another similar study on diabetic rats has demonstrated the preventive nature of the protein concentrate of proso millet and stated that it directly affects the D-glucosamine induced liver injuries in rats.

Health Benefits of Nutri-cereals (sridhanya)

Obesity- Obesity is the biggest emerging problem in India, and it is associated with several chronic diseases including diabetes and cardiovascular diseases²⁵. Recent studies show that intake of high dietary fiber decreases the incidence of obesity.

Foods' rich in dietary fiber improve the bowel function and slows the process of digestion and absorption, thereby reducing the risk of chronic diseases. The dietary fiber content present in millets is 22% which is comparatively higher than other cereals like wheat and rice

Diabetes- Millets reduces the α -glucosidase and pancreatic amylase thereby reducing the postprandial hyperglycemia by reducing the enzymatic hydrolysis of complex carbohydrates. Hence consuming millets helps in controlling the blood glucose levels²⁶.

Millets helps in prevention of type II diabetes due to their significant levels of magnesium. Magnesium is an important mineral which helps in increasing the efficiency of insulin and glucose receptors by producing many carbohydrate digesting enzymes, which manages insulin action.

Cardio-Vascular Diseases- Millets are rich source of magnesium, which is an important mineral for reducing blood pressure and the risk of heart attacks, particularly in the case of atherosclerosis²⁶. Millets are also a great source of potassium, which further keeps blood pressure low by acting as a vasodilator. Reducing the blood pressure and optimizing the circulatory system is one of the best ways to protect cardiovascular health.

Millets are also rich in Phyto-chemicals which contain phytic acid helping in lowering cholesterol and preventing cardiovascular disease by reducing plasma triglycerides.

Studies suggested that regular consumption of whole millet grains reduces the risk of Cardio-Vascular Diseases.

Cancer- Millets are rich in phenol acids, phytates and tannins which are the anti nutrients that help in reducing the risk of colon and breast cancer²⁷.

Celiac Disease- Celiac disease is a genetically susceptible problem triggered by the consumption of gluten, a protein found in cereals like wheat and rye that gives sticky nature to the food products like *chapatti, roti, parota* etc²⁸. As the millets are gluten free, they help in reducing the celiac disease by reducing the irritation caused by the common cereal grains which contain gluten.

Phytochemicals- Millets are good source of phytochemicals and micronutrients. Phytochemicals like phenolics, sterols, lignans, resistant starch, β -glucan, phytates, tocopherol, dietary fiber and carotenoids are present in millets²⁸. The polyphenols are the phenolic acids and tannins, flavonoids are present in small quantities, which act as antioxidant and play a role in protection of body's immune system.

Millets contain phosphorous that plays a major role in cell structure developments. In addition to its role in forming the mineral matrix of bone besides it is an essential component of numerous compounds including adenosine triphosphate (ATP), the molecule that is the energy currency of the body^{29, 30}. Phosphorous is an important component of nucleic acids, the building blocks of the genetic code. In addition to the metabolism of lipids, phosphorous is an essential component of lipid-containing structures such as cell membranes and nervous system structures.

Conclusion-

Underutilized millets are Nutri-cereals and must be implemented in the developing countries like India due to their high nutritional qualities, healthy dietary fibre concentration and likewise effective in small as well as large scale supplements and best agent for fortification. Millets are nutrients rich and contain iron, calcium, manganese, magnesium, zinc, potassium, and phosphorus. Millets are gluten-free, alkaline in nature, soothing, and intestinal friendly so gluten/wheat intolerants and constipation patients can consume them. Its cells and tissue maintenance actions are effective in inflammations. Millets contain tannins, phenol mixes, flavonoids, and other important amino and fatty acids. These are effectively edible and rich in β -carotenoids and lecithin so functional food can be prepared as pasta, noodles, biscuits multigrain

floor, etc., these help in keeping down the cholesterol like LDL, VLDL, triglycerides, hypertension.

Millet also decrease the chances of getting various type of malignant growths and cardiovascular disease. All the aforementioned nutrients provide energy to body for the growth, maintenance, reproduction, and for performing all the body functions. Millets as high-energy nutritious food if utilized properly can combat malnutrition, obesity, diabetes, cardiovascular disease, protein-energy malnutrition, celiac disease, etc., as free from gluten. Millet is a yield with dry season safe characteristics, simple to process; it contains a high measure of lecithin and is magnificent for reinforcing the sensory system. Millets are plentiful in vitamins; and contains vitamins A, B, D, and E, particularly (B3) niacin, B6, and B9, just as the minerals; calcium, iron, and many other minerals. Proper millet utilization can help us easily to overcome many pre and post-transition diseases and can create a healthy and disease-free environment in our country. However, bio-fortification and development of some functional foods (biscuits, slices of bread, pasta, noodles, beverage powder etc.) can also be a potential alternative.

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